National Park Service
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Natural Resource Stewardship and Science

Invasive Exotic Plant Monitoring at Powder Mill Natural Area, Ozark National Scenic Riverways

Year 1 (2011)

Natural Resource Data Series NPS/HTLN/NRDS—2013/438

ON THE COVER
Autumn olive (*Elaeagnus umbellata*) near Powder Mill Natural Area, Ozark National Scenic Riverway.
Photograph by: Adam Throckmorton, National Park Service

Invasive Exotic Plant Monitoring at Powder Mill Natural Area, Ozark National Scenic Riverways

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Craig C. Young, Chris M. Kopek, and Chad S. Gross

National Park Service, Heartland I&M Network
Wilson's Creek National Battlefield
6424 West Farm Road 182
Republic, MO 64738

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The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Introduction

Ozark National Scenic Riverways includes 80,785 acres along the Current and Jack's Fork Rivers in Shannon, Carter, Dent, and Texas counties in Missouri. Located in the Current River Hills subsection of the Ozark Highlands physiographic province (Nigh and Schroeder 2002), the park protects numerous springs and 10 natural areas. The natural areas in the park are designated under the auspices of the Missouri Department of Conservation. Natural areas are selected to represent rare or exemplary relatively undisturbed assemblages of animals, plants, and physical features. For this reason, invasive plant management on the park is typically prioritized towards these areas.

Documenting non-random distributions of invasive plants could allow managers to concentrate on areas with a high probability of finding these plants. Stroh and Stuckhof (2009) documented higher frequency and mean number of non-native plants along horse trails compared to old roads (without horse traffic). Overall frequency between intact areas and old roads was similar. The study also found a higher non-native to native plant ratio in river bottoms compared to glades. These ratios were both similar to plant communities along upland waterways . These observations contrasted somewhat with those in a study evaluating the location and abundance of plants in the vicinity of Big Springs Natural Area (Short et al. 2010). Most invasive plants were associated with roads, trails, open fields, and riparian areas. In our field observations, this distribution fits many species such as Chinese lespedeza (*Lespedeza cuneata*), garlic mustard (*Alliaria petiolata*), Johnsongrass (*Sorghum halepense*), and spotted knapweed (*Centaurea biebersteinii*). Autumn olive (*Elaeagnus umbellata*), Japanese honeysuckle (*Lonicera japonica*), mimosa (*Albizia julibrissin*), multiflora rose (*Rosa multiflora*), and wisteria (*Wisteria sinensis*), however, are exceptions to this rule that we have observed within forests.

Methods

Watch lists

Invasive exotic plant species on two watch lists (Table 1) were sought during monitoring. Plants designated as high priority invasive species (Young et al. 2007) and not known to occur on the park per NPSpecies Application constituted the "early detection watch list". Designated invasive exotic plants known to occur on the park per NPSpecies constituted the "park-established watch list". Black locust (*Robinia pseudocacaia*) was also included on the park established list, but is native to the United States. While aquatic species were included on the watch lists, terrestrial plants were the focus of this survey.

Field methods

Between June 13-16 and 20-22, 2011, Chris Kopek identified invasive plant species on designated watch lists in the Powder Mill Natural Area (Figure 1). Using a Trimble GeoXT GPS unit, Chris navigated along contiguous 200 m line transects, identified invasive exotic plants in a 3 m- to 12 m-belt, and attributed a coarse cover value to each species (0=0, 1=0.1-0.9 $m^{2,}$ 2=1-9.9 $m^{2,}$, 3=10-49.9 $m^{2,}$, 4= 50-99.9 $m^{2,}$, 5=100-499.9 $m^{2,}$, 6= 500-999.9 $m^{2,}$, and 7=1,000 m^2-4,999 m^2. The widest belt possible given site conditions was used. The study area consisted of 144 transects; we sampled 129 of these (Figure 1). The majority of transects not sampled were located on property owned by the Missouri Department of Conservation.

Analytical methods

Data analysis involved calculation of plant cover and frequency. Maps were also constructed. The invasive exotic plants encountered within the study area at Ozark National Scenic Riverways were attributed to line transects in a GIS (Figures 3-17). A park-wide cover range was then estimated for each invasive exotic plant encountered.

To calculate the cover range, we first calculated the observed reference frame fraction by multiplying transect length, the number of transects, and the belt width. The belt width was either 3 m (the minimum possible width) or 12 m (the maximum possible width). The product was then divided by the reference frame area (Eq. 1). We calculated transect lengths using the mean sample unit size and assuming square search units.

$$\text{Eq. 1. Fraction of area searched} = \frac{\textit{transect length} * \textit{number of transects} * \textit{belt width}}{\textit{reference frame area}}$$

The minimum fraction of area searched (belt width = 3 m) was 1.5%, and the maximum fraction of area searched (belt width = 12 m) was 6%.

To calculate the minimum end of the estimated cover range for each species, we summed the lower endpoints associated with the assigned cover class values for that species and then divided by the reference frame fraction observed assuming the widest possible survey belt (i.e., maximum fraction observed) (12 m) (Eq. 2).

$$\text{Eq. 2. Minimum cover estimate} = \frac{\Sigma\ \textit{low end of cover value range for species}}{\textit{fraction of area searched assuming 12-m belt width}}$$

Maximum cover for each species was calculated similarly, using the upper endpoints of the cover values in each occupied search unit and assuming that a 3-m belt was surveyed (i.e., minimum fraction of area observed) (Eq. 3).

$$\text{Eq. 3. Maximum cover estimate} = \frac{\Sigma\ \textit{high end of cover value range for species}}{\textit{fraction of area searched assuming 3-m belt width}}$$

Taken together, the minimum and maximum cover estimates provided an estimated range of cover that accounts for the uncertainty arising from the sampling method. Non-overlapping ranges represented the strongest evidence for differences in abundance.

The park-wide frequency of invasive exotic plants was calculated as the percentage of occupied search units (Eq. 4).

$$\text{Eq. 4. Frequency of an IEP species} = \frac{\Sigma\ \textit{units occupied by species}}{\Sigma\ \textit{units sampled}} \text{ X100}$$

To assess the relationship between roads, trails, streams and invasive plant occurrence, each transect was enveloped in a square that used that transect as a bisecting axis (Figure 2). We then

characterized the transects as having or not having streams, trails, or roads based on an intersection of the square with those linear features (Figure 2). We also characterized each transect as supporting or not supporting invasive plants based on the survey findings. We then conducted a chi-square test to analyze the relationship between the invasive plant occurrence and these linear features.

Invasiveness ranks

To provide additional information on the ecological impact and feasibility of control, the ecological impact and general management difficulty sub-ranks that constitute the invasiveness rank (I-rank), as determined by NatureServe (Morse et al. 2004), were listed when available. The ecological impact characterizes the effect of the plant on ecosystem processes, community composition and structure, native plant and animal populations, and the conservation significance of threatened biodiversity. General management difficulty ranks are assigned based on the resources and time generally required to control a plant, the non-target effects of control on native populations, and the accessibility of invaded sites. Sub-ranks are given as high (H), medium (M), low (L), insignificant (I), unknown (U), or a combination of ranks.

Results and Discussion

In 2011, a total of 15 invasive exotic plant species were found during the survey in Powder Mill Natural Area, Ozark National Scenic Riverways (Table 2). The frequencies and abundances of all invasive exotic species within the study area were relatively low. Because of the low fraction of the area observed, however, more populations undoubtedly occur in the study area. The most abundant and widely distributed species, multiflora rose (*Rosa multiflora*), occupied only 7.8% of transects and at most 1.2 acres within the study area. Most of the species identified in the study grow in open, high-light environments. Autumn olive, multiflora rose, and Nepalese browntop (*Microstegium vimineum*) are exceptions to this and can grow beneath intact canopies.

The invasive plants found in Powder Mill Natural Area were strongly associated with the location of roads, trails, and streams (chi-square=39.31, $p=2.4x10^{-9}$). A total of 51 out of 129 (39.5%) transects supported roads, trails or streams, while 29 (22.5%) transects supported at least one invasive plant. Of the 29 transects with at least one invasive plant, 26 (90%) contained roads, trails or streams. In contrast, only 25 (25%) of the 100 transects without invasive plants contained roads, trails or streams. Given limited resources, search efforts focused on these corridors are the most likely to find the majority of invasive plants in the park.

While recognizing these patterns is helpful, managers are still left with several decisions about the potential of these invasive species to spread and the feasibility of their treatment. Managers would benefit from a determination as to whether plant species located along road sides are naturally restricted by forest canopies or whether they may spread beyond the road. We suggest that open fields and glades with reduced canopies adjacent to roads are more likely to be invaded than forests with a full canopy. In riparian areas, repeated flooding is likely to further spread invasive plant propagules. Assuming that treatment is at all feasible in these areas, management actions for these species should begin in the headwaters of a given watershed and continue in a downstream direction.

Literature Cited

Nigh, T. A. and W. A. Schroeder. 2002. Atlas of Misouri Ecoregions. Missouri Department of Conservation.

NPSpecies - The National Park Service Biodiversity Database. IRMA version. https://irma.nps.gov/Species.mvc/Welcome (accessed 16 February 2012).

Short, M. F., C. C. Young, C. S. Gross, and J. L. Haack. 2010. Invasive exotic plant monitoring at Big Spring Pines Natural Area, Chubb Hollow, Long Bay Field and Long Bay at Ozark National Scenic Riverways: Year 1 (2010). Natural Resource Technical Report NPS/HTLN/NRTR—2010/444. National Park Service, Fort Collins, Colorado.

Stroh, E. D., and M. S. Struckhoff. 2009. Exotic plant species associations with horse trails, old roads, and intact native communities in the Missouri Ozarks. Natural Areas Journal 29(1): 50-56.

Young, C.C., J.L. Haack, L.W. Morrison, and M.D. DeBacker. 2007. Invasive exotic plant monitoring protocol for the Heartland Inventory and Monitoring Program. Natural Resource Report NPS/HTLN/NRR-2007/018. National Park Service, Fort Collins, Colorado.

Table 1. Invasive plant watch lists for Ozark National Scenic Riverways.

Early Detection Watch List		Park-Established Watch List	
Acer ginnala	Amur maple	*Albizia julibrissin*	Mimosa
Ailanthus altissima	tree of heaven	*Arctium minus*	Smaller burdock
Alnus glutinosa	European alder	*Bromus tectorum*	Cheat grass
Albizia julibrissin	silktree	*Centaurea stoebe ssp. micranthos*	Spotted knapweed
Alliaria petiolata	garlic mustard	*Cirsium vulgare*	Common thistle
Arundo donax	giant reed	*Daucus carota*	Queen Anne's lace
Arctium minus	lesser burdock	*Hypericum perforatum*	Common St Johnswort
Berberis thunbergii	Japanese barberry	*Leonurus cardiaca*	Common motherwort
Bothriochloa bladhii	Caucasian bluestem	*Lespedeza cuneata*	Chinese lespedeza
Bromus inermis	smooth brome	*Lysimachia nummularia*	Moneywort
Bromus racemosus	bald brome	*Melilotus officinalis*	Yellow sweet-clover
Bromus sterilis	poverty brome	*Poa compressa*	Canada bluegrass
Bromus tectorum	cheatgrass	*Poa pratensis*	Kentucky bluegrass
Carduus nutans	nodding plumeless thistle	*Potentilla recta*	Sulphur cinquefoil
Celastrus orbiculatus	Oriental bittersweet	*Rosa multiflora*	Multiflora rose
Centaurea solstitialis	yellow star-thistle	*Rorippa nasturtium-aquaticum*	Watercress
Centaurea stoebe ssp. micranthos	spotted knapweed	*Robinia pseudoacacia*	Black locust
Cirsium arvense	Canada thistle	*Rumex acetosella*	Red (or sheep) sorrel
Cirsium vulgare	bull thistle	*Rumex crispus*	Narrowleaf dock
Cornus foemina	stiff dogwood	*Saponaria officinalis*	Soapwort
Cynanchum louiseae	Louise's swallow-wort	*Sorghum halepense*	Herbe de Cuba
Cynanchum rossicum	European swallow-wort	*Torilis arvensis*	Spreading hedgeparsley
Daucus carota	Queen Anne's lace	*Verbascum thapsus*	Velvet plant
Dipsacus fullonum	Fuller's teasel		
Dipsacus laciniatus	cutleaf teasel		
Dioscorea oppositifolia	Chinese yam		
Egeria densa	Brazilian waterweed		
Eichhornia crassipes	common water hyacinth		
Elaeagnus umbellata/angustifolia	elaeagnus		
Elaeagnus angustifolia	Russian olive		
Elymus repens	quackgrass		
Elaeagnus umbellata	autumn olive		
Euonymus alata	burningbush		

Table 1. (continued)

Early Detection Watch List		Park-Established Watch List
Euphorbia cyparissias	cypress spurge	
Euphorbia esula	leafy spurge	
Euonymus fortune	winter creeper	
Glechoma hederacea	ground ivy	
Hemerocallis fulva	orange daylily	
Hedera helix	English ivy	
Hesperis matronalis	dames rocket	
Holcus lanatus	common velvetgrass	
Humulus japonicus	Japanese hop	
Hypericum perforatum	common St. Johnswort	
Iris pseudacorus	paleyellow iris	
Lespedeza bicolor	shrub lespedeza	
Leonurus cardiac	common motherwort	
Lespedeza cuneata	sericea lespedeza	
Lepidium latifolium	broadleaved pepperweed	
Ligustrum obtusifolium	border privet	
Ligustrum sinense	Chinese privet	
Linaria vulgaris	butter and eggs	
Lotus corniculatus	bird's-foot trefoil	
Lonicera japonica	Japanese honeysuckle	
Lolium spp	ryegrass	
Lonicera maackii	Amur honeysuckle	
Lonicera morrowii	Morrow's honeysuckle	
Lysimachia nummularia	creeping jenny	
Lythrum salicaria	purple loosestrife	
Maclura pomifera	osage orange	
Melilotus officinalis	Sweetclover	
Miscanthus sinensis	Chinese silvergrass	
Microstegium vimineum	Nepalese browntop	
Morus alba	white mulberry	

Table 1. (continued)

Early Detection Watch List		Park-Established Watch List
Myriophyllum aquaticum	parrot feather watermilfoil	
Myosotis scorpioides	true forget-me-not	
Myriophyllum spicatum	Eurasian watermilfoil	
Najas minor	brittle waternymph	
Rorippa nasturtium-aquaticum	watercress	
Onopordum acanthium	Scotch cottonthistle	
Pastinaca sativa	wild parsnip	
Paulownia tomentosa	princesstree	
Phalaris arundinacea	reed canarygrass	
Phragmites australis	common reed	
Populus alba	white poplar	
Poa compressa	Canada bluegrass	
Potamogeton crispus	curly pondweed	
Polygonum cuspidatum	Japanese knotweed	
Poa pratensis	Kentucky bluegrass	
Potentilla recta	sulphur cinquefoil	
Populus tremuloides	quaking aspen	
Prunus mahaleb	Mahaleb cherry	
Pueraria montana var. lobata	kudzu	
Rhamnus cathartica	common buckthorn	
Rhus glabra	smooth sumac	
Rosa multiflora	multiflora rose	
Robinia pseudoacacia	black locust	
Rumex acetosella	common sheep sorrel	
Rumex crispus	curly dock	
Saponaria officinalis	bouncingbet	
Lolium arundinaceum	tall fescue	
Lolium pretense	meadow fescue	
Sesbania herbacea	bigpod sesbania	
Coronilla varia	crownvetch	
Sonchus arvensis	field sowthistle	
Sorghum halepense	Johnsongrass	
Spiraea japonica	Japanese meadowsweet	
Tanacetum vulgare	common tansy	

Table 1. (continued)

Early Detection Watch List		Park-Established Watch List
Torilis arvensis	spreading hedgeparsley	
Torillis japonica	erect hedgeparsley	
Typha angustifolia	narrowleaf cattail	
Typha X glauca		
Ulmus pumila	Siberian elm	
Verbascum thapsus	common mullein	
Vinca minor	common periwinkle	
Viburnum opulus	European cranberrybush	
Wisteria sinensis	Chinese wisteria	

Table 2. Overview of invasive exotic plants found in Ozark National Scenic Riverways. Ecological impact and general management difficulty based on NatureServe I-Rank subranks, Morse et al. 2004. Subranks are given as high (H), medium (M), low (L), insignificant (I), unknown (U), or not available (--).

Scientific Name	Common Name	Watch list	2011 Park-wide cover (acres)	2011 Frequency (%)	Ecological impact	Management difficulty
Centaurea stoebe L. ssp. Micranthos	Spotted knapweed	Early Detection	0.0004-1.0	1.6	M	HL
Daucus carota	Queen Anne's lace	Park Established	0.001-0.04	4.7	I	I
Elaeagnus umbellata	Autumn olive	Early Detection	0.04-0.9	5.4	H	L
Glechoma hederacea	Ground ivy	Early Detection	0.003-0.1	2.3	MI	U
Lespedeza cuneata	Sericea lespedeza	Early Detection	0.3-0.7	7.8	ML	ML
Lysimachia nummularia	Creeping jenny	Early Detection	0.03-0.7	6.2	L	L
Melilotis officinalis	Sweetclover	Early Detection	0.01-0.4	6.2	M	M
Microstegium vimineum	Nepalese browntop	Early Detection	0.005-0.2	3.9	M	HM
Potentilla recta	Sulphur cinquefoil	Early Detection	0.0002-0.007	0.8	HL	ML
Rosa multiflora	Multiflora rose	Early Detection	0.05-1.2	7.8	L	L
Robinia pseudoacacia	Black locust	Early Detection	0.0002-0.007	0.8	HM	M
Rumex crispus	Curly dock	Early Detection	0.0006-0.02	2.3	LI	ML
Schedonorus phoenix	Tall fescue		0.003-0.1	3.1	M	HM
Sorghum halepense	Johnsongrass	Early Detection	0.0006-0.02	2.3	ML	HM
Torilis arvensis	Spreading hedgeparsley	Park Established	0.0002-0.007	0.8	----	----

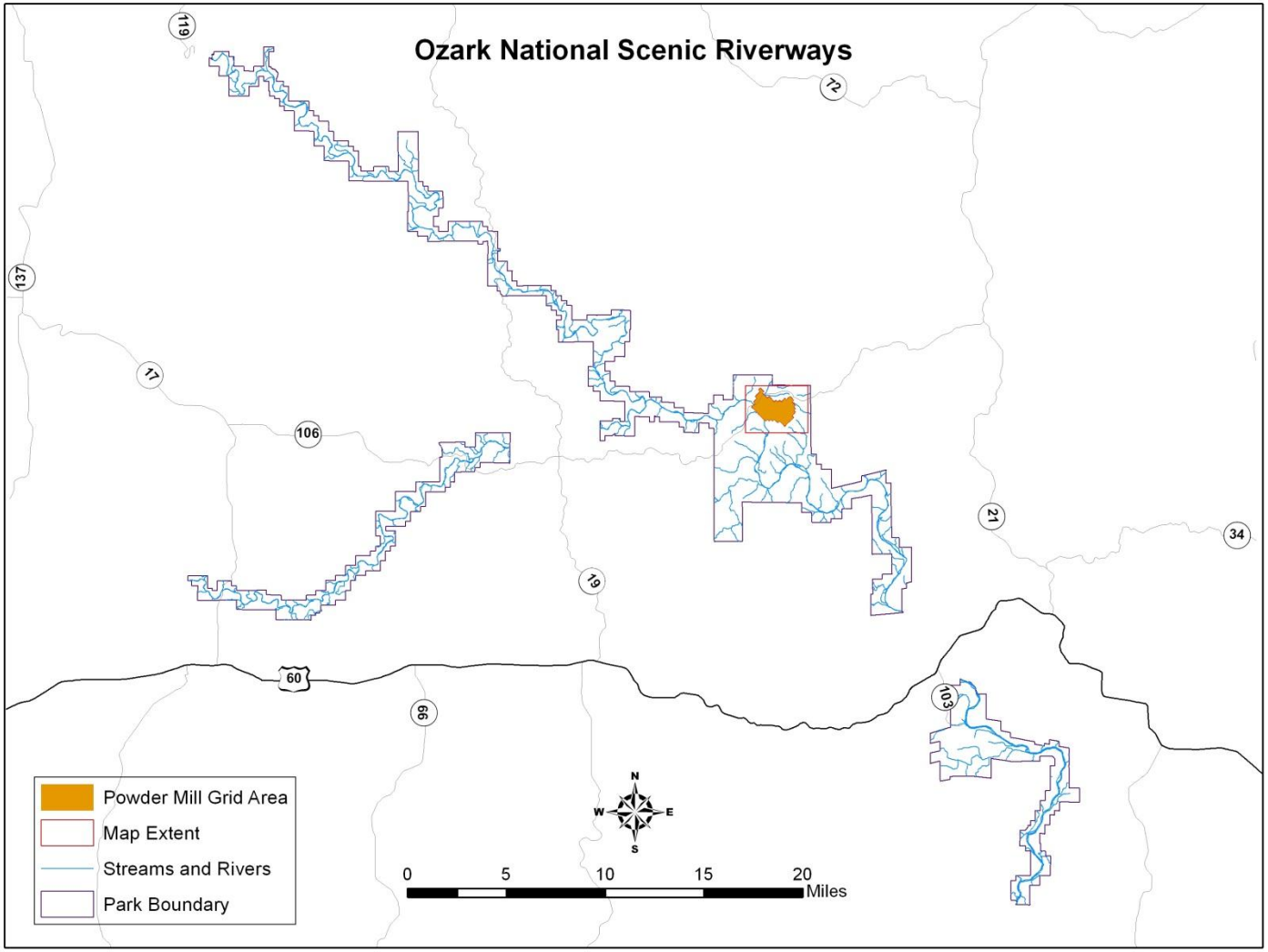

Figure 1. Location of Powder Mill Natural Area within Ozark National Scenic Riverways.

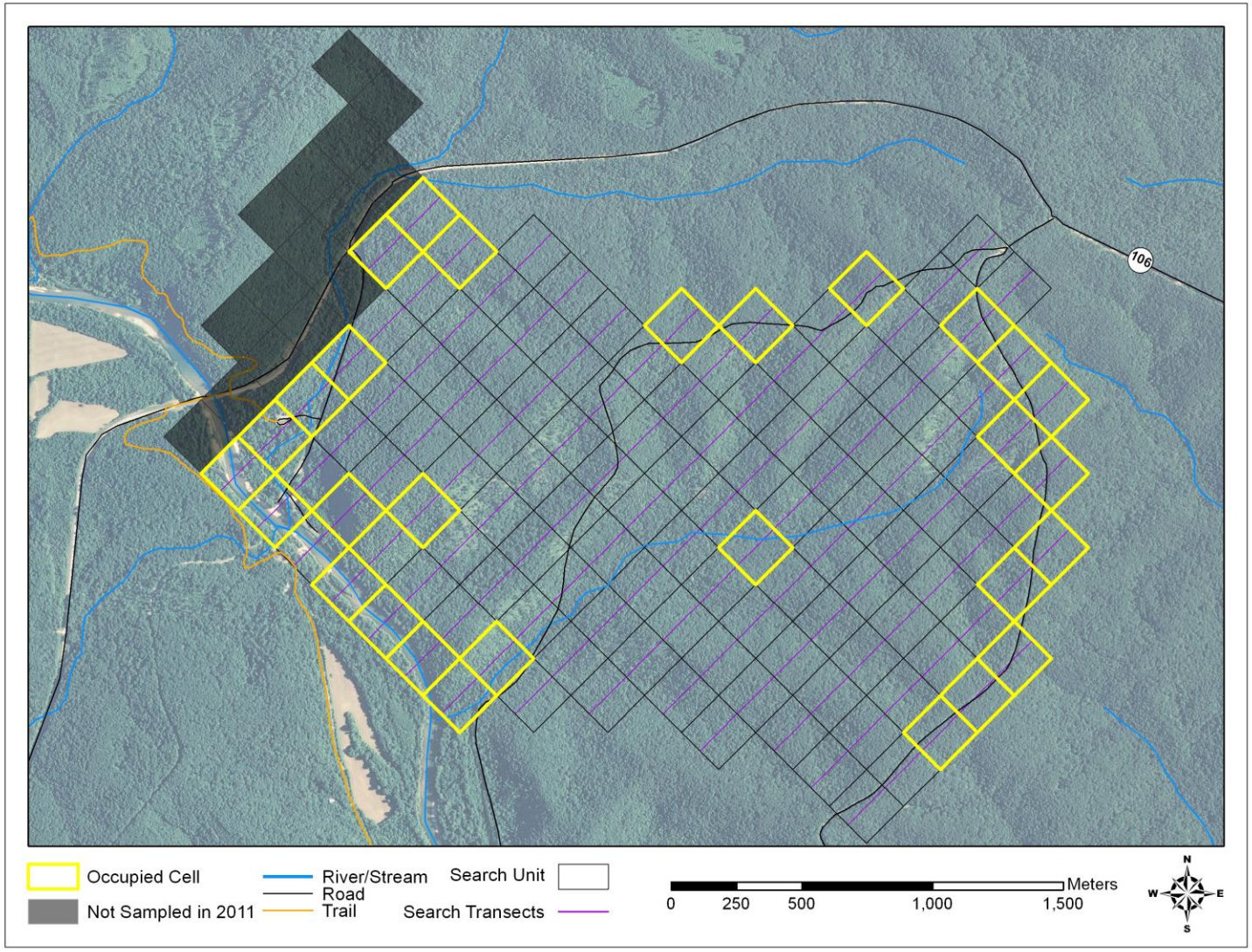

Figure 2. Search units within Powder Mill Natural Area, Ozark National Scenic Riverways. Search units outlined in red supported one or more invasive plant species. Shaded cells were not sampled during the survey.

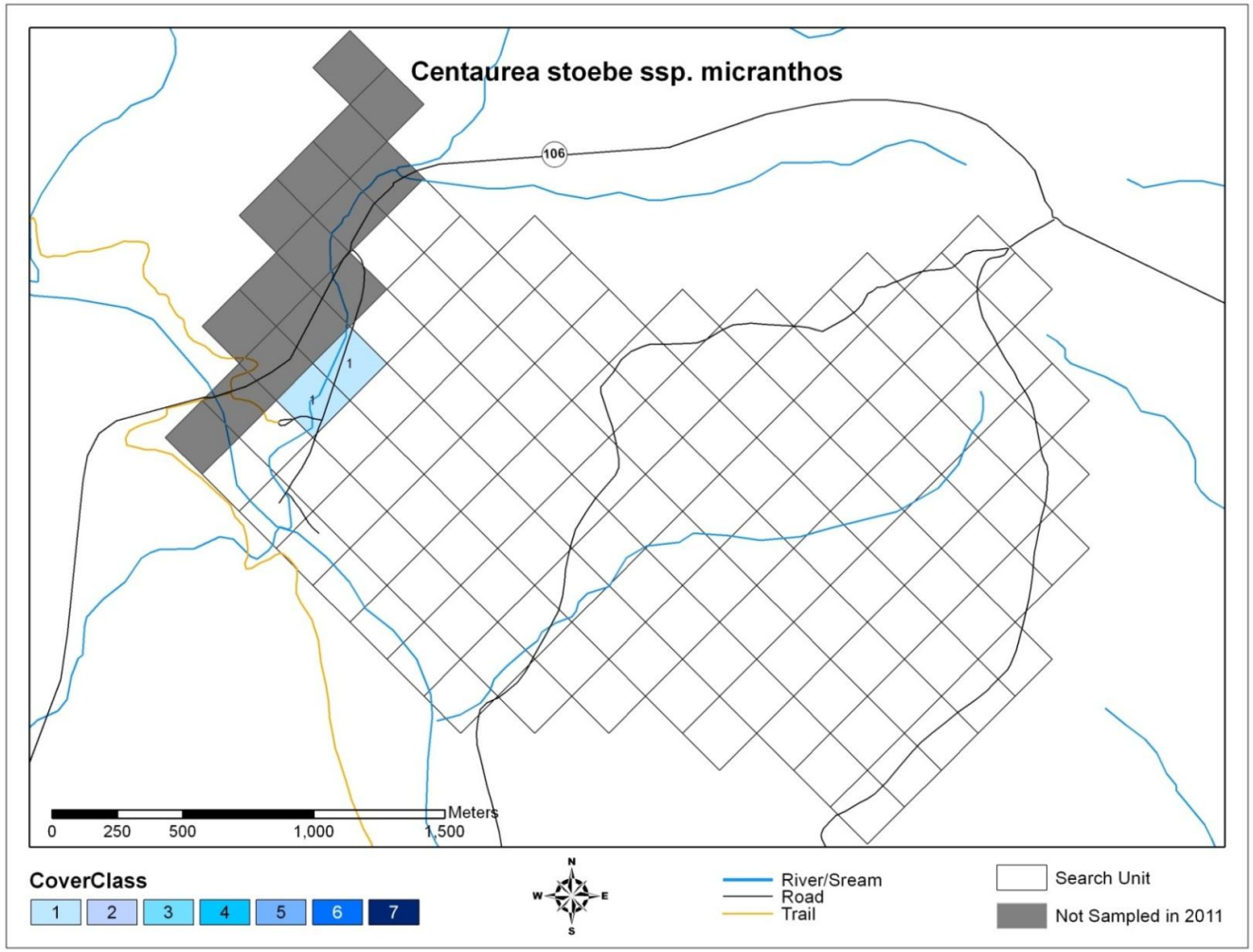

Figure 3. Abundance and distribution of *Centaurea stoebe* ssp. *micranthos* (spotted knapweed) at Ozark National Scenic Riverways, 2011. Cover classes are as follows: 1=0.1-0.9 m^2, 2=1-9.9 m^2, 3=10-49.9 m^2, 4= 50-99.9 m^2, 5=100-499.9 m^2, 6= 499.9-999.9 m^2, 7= 1,000-4,999 m^2.

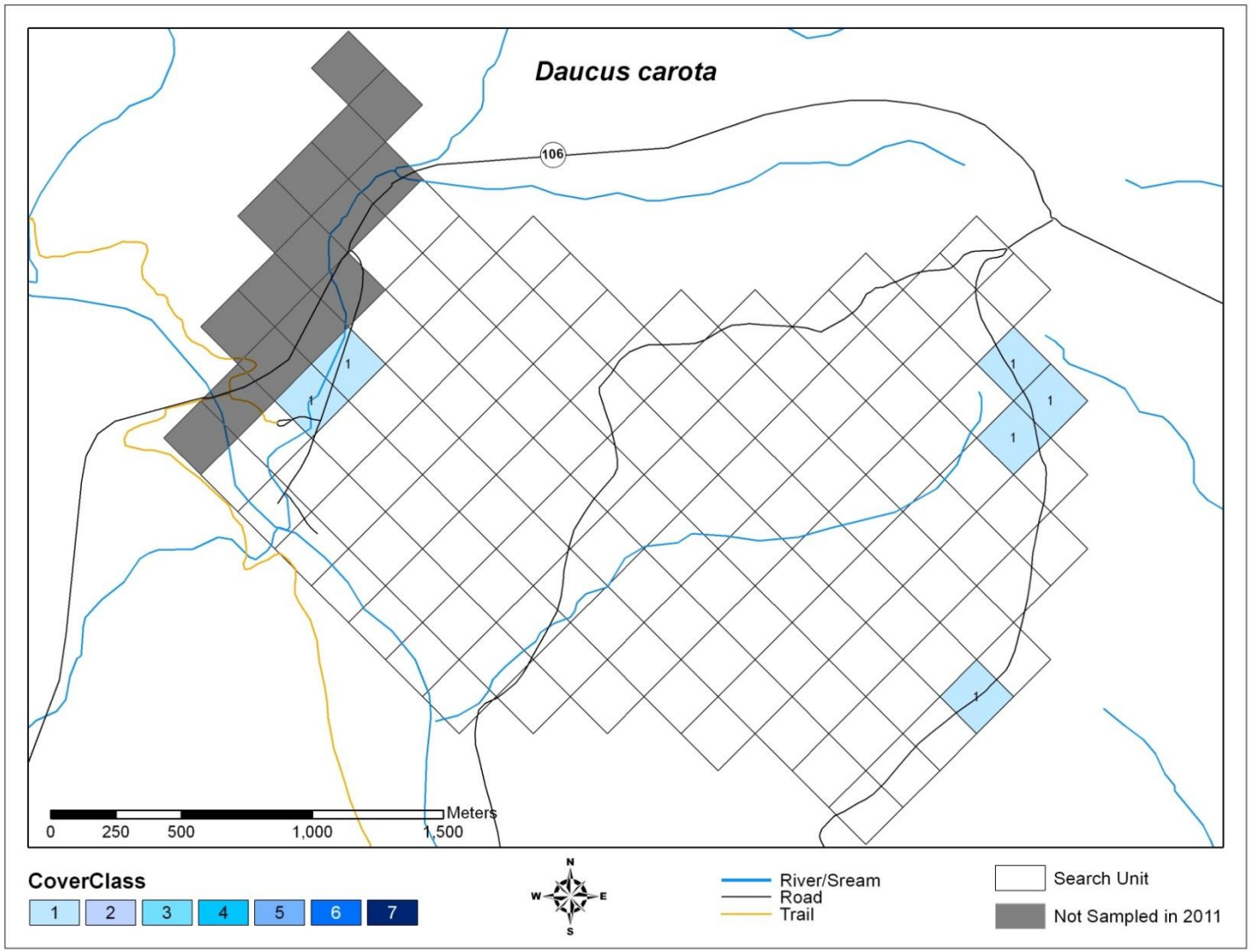

Figure 4. Abundance and distribution of *Daucus carota* (Queen Anne's lace) at Ozark National Scenic Riverways, 2011. Cover classes are as follows: 1=0.1-0.9 m^2, 2=1-9.9 m^2, 3=10-49.9 m^2, 4= 50-99.9 m^2, 5=100-499.9 m^2, 6= 499.9-999.9 m^2, 7= 1,000-4,999 m^2.

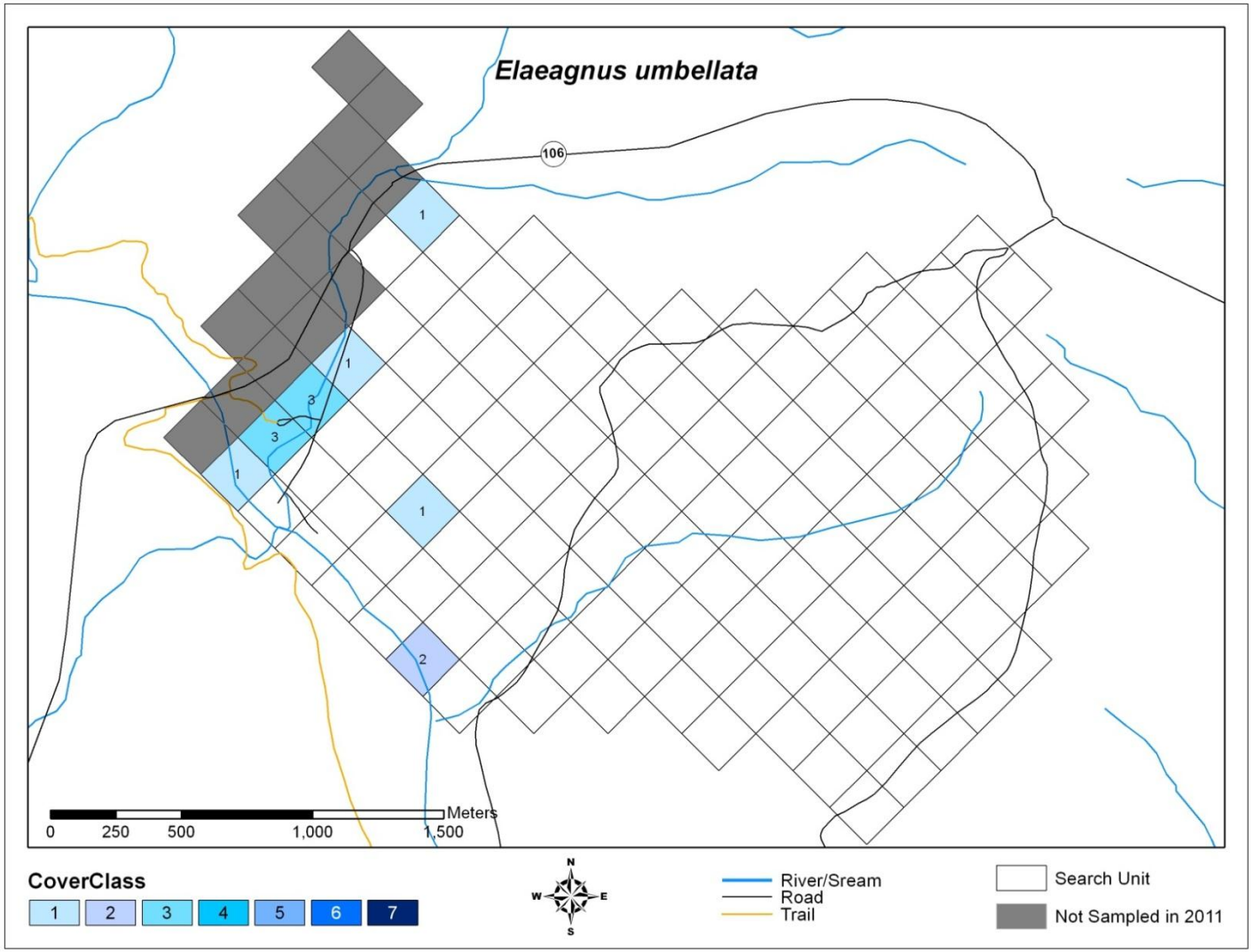

Figure 5. Abundance and distribution of *Elaeagnus umbellata* (Autmn olive) at Ozark National Scenic Riverways, 2011. Cover classes are as follows: 1=0.1-0.9 m^2, 2=1-9.9 m^2, 3=10-49.9 m^2, 4= 50-99.9 m^2, 5=100-499.9 m^2, 6= 499.9-999.9 m^2, 7= 1,000-4,999 m^2.

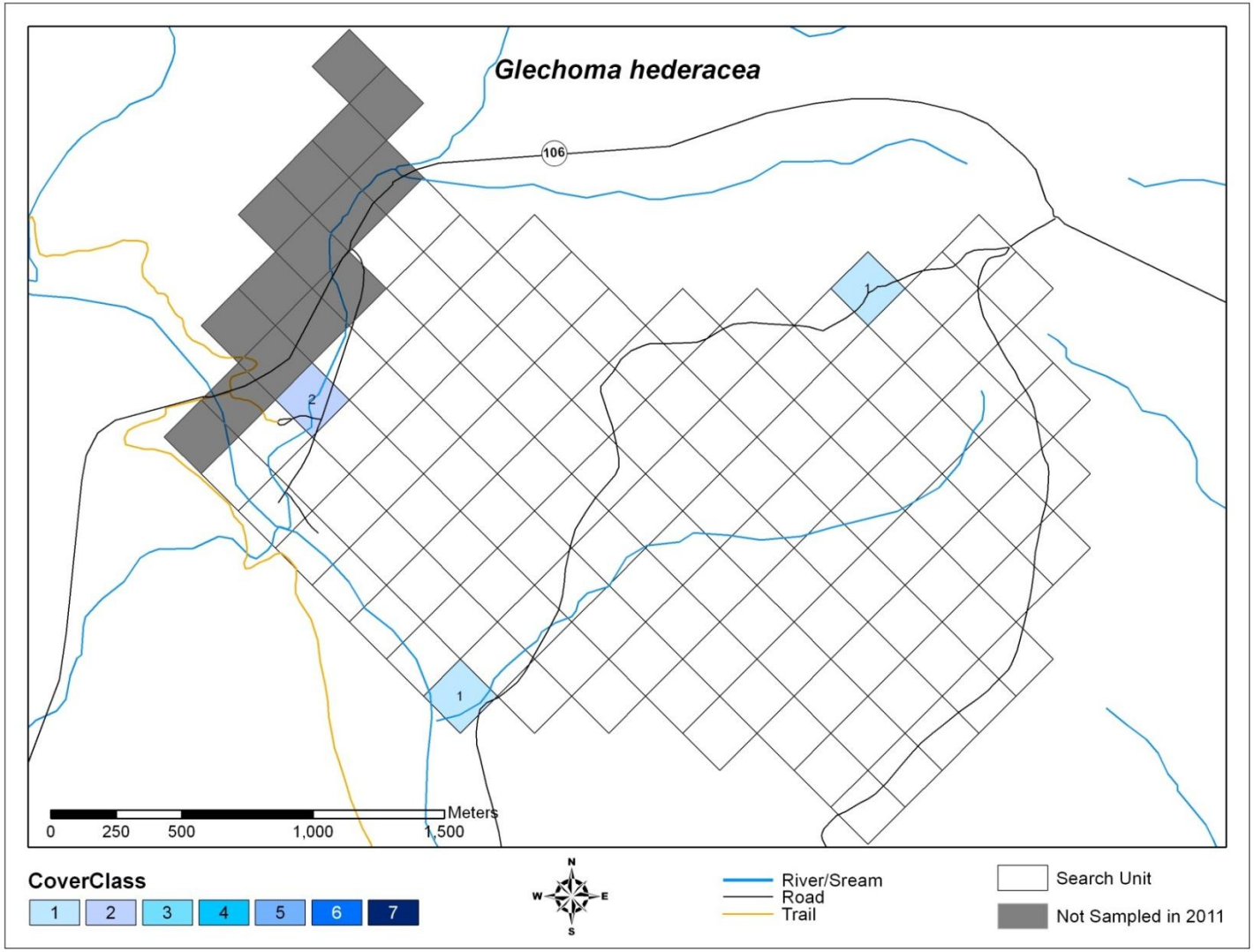

Figure 6. Abundance and distribution of *Glechoma hederacea* (ground ivy) at Ozark National Scenic Riverways, 2011. Cover classes are as follows: 1=0.1-0.9 m^2, 2=1-9.9 m^2, 3=10-49.9 m^2, 4= 50-99.9 m^2, 5=100-499.9 m^2, 6= 499.9-999.9 m^2, 7= 1,000-4,999 m^2.

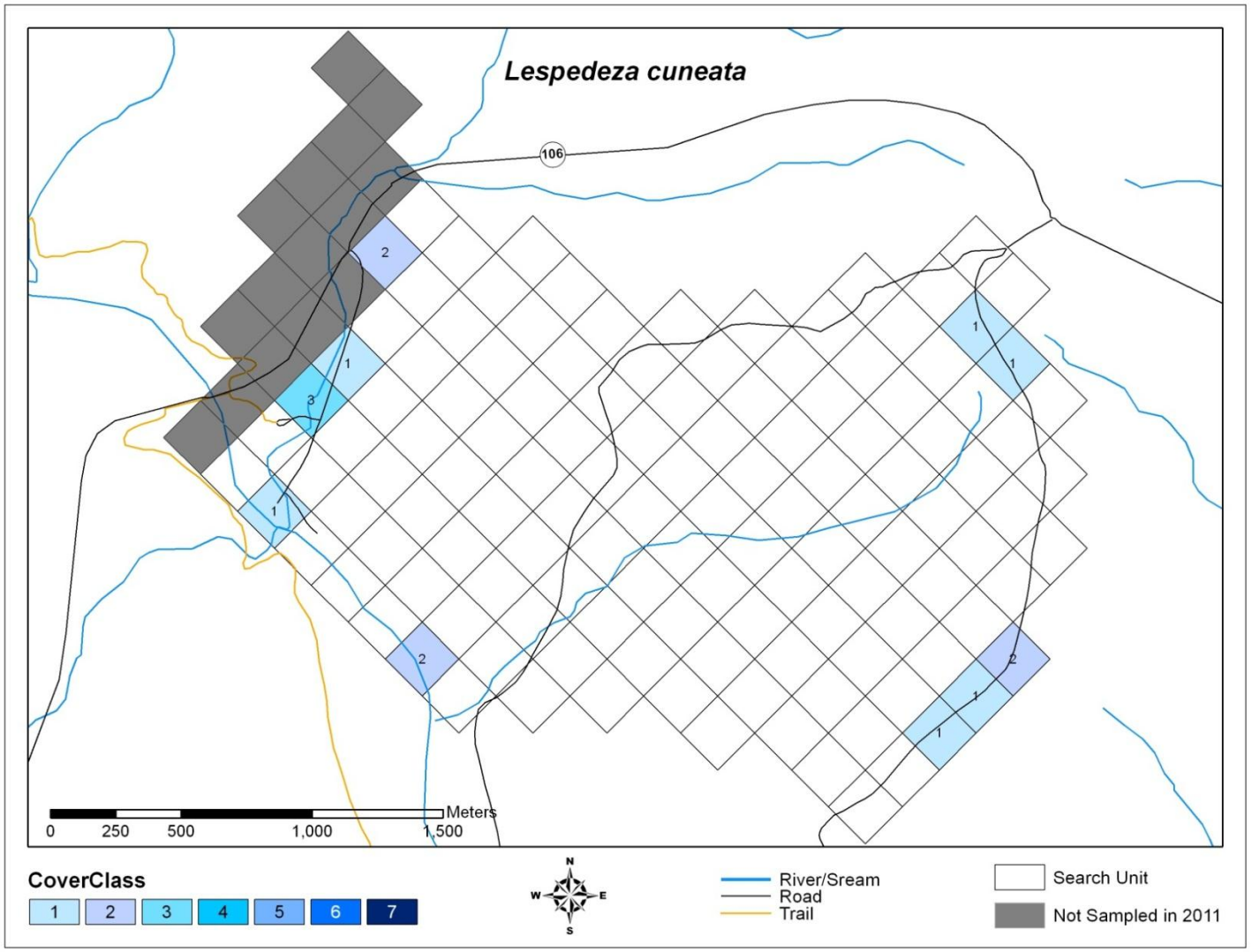

Figure 7. Abundance and distribution of *Lespedeza cuneata* (sericea lespedeza) at Ozark National Scenic Riverways, 2011. Cover classes are as follows: 1=0.1-0.9 m^2, 2=1-9.9 m^2, 3=10-49.9 m^2, 4= 50-99.9 m^2, 5=100-499.9 m^2, 6= 499.9-999.9 m^2, 7= 1,000-4,999 m^2.

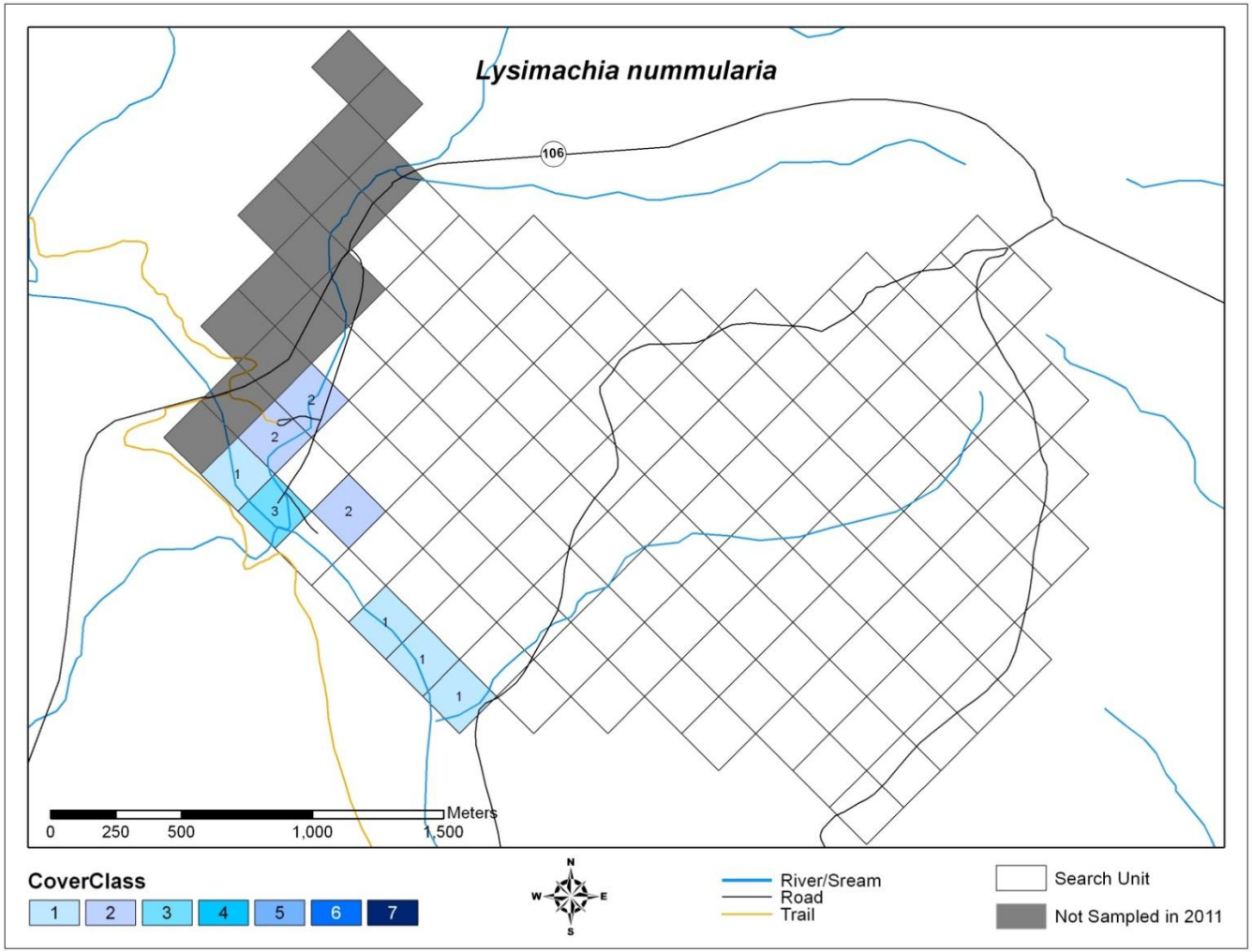

Figure 8. Abundance and distribution of *Lysimachia nummularia* (creeping jenny) at Ozark National Scenic Riverways, 2011. Cover classes are as follows: 1=0.1-0.9 m^2, 2=1-9.9 m^2, 3=10-49.9 m^2, 4= 50-99.9 m^2, 5=100-499.9 m^2, 6= 499.9-999.9 m^2, 7= 1,000-4,999 m^2.

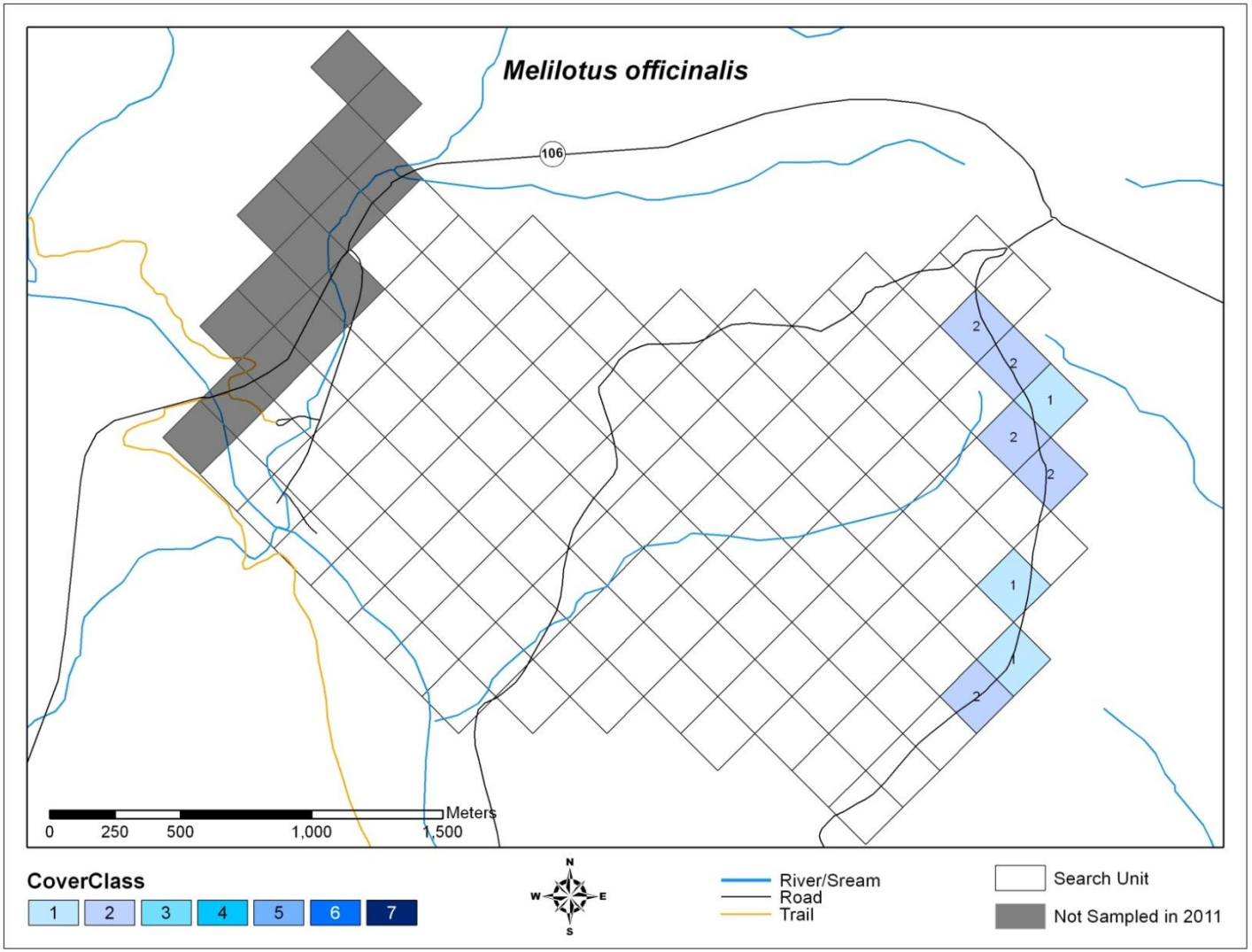

Figure 9. Abundance and distribution of *Melilotus officinalis* (sweetclover) at Ozark National Scenic Riverways, 2011. Cover classes are as follows: 1=0.1-0.9 m^2, 2=1-9.9 m^2, 3=10-49.9 m^2, 4= 50-99.9 m^2, 5=100-499.9 m^2, 6= 499.9-999.9 m^2, 7= 1,000-4,999 m^2.

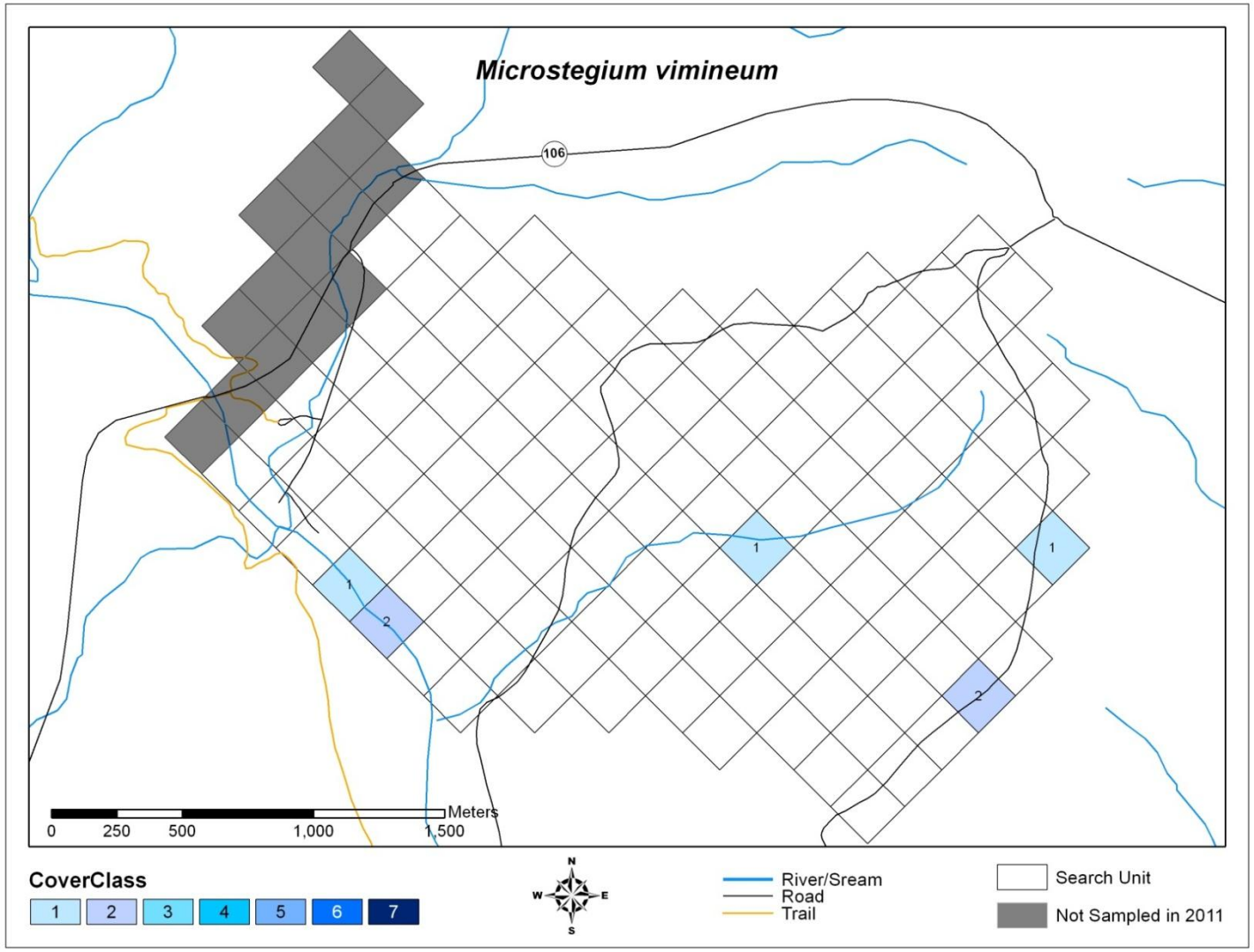

Figure 10. Abundance and distribution of *Microstegium vimineum* (Nepalese browntop) at Ozark National Scenic Riverways, 2011. Cover classes are as follows: 1=0.1-0.9 m^2, 2=1-9.9 m^2, 3=10-49.9 m^2, 4= 50-99.9 m^2, 5=100-499.9 m^2, 6= 499.9-999.9 m^2, 7= 1,000-4,999 m^2.

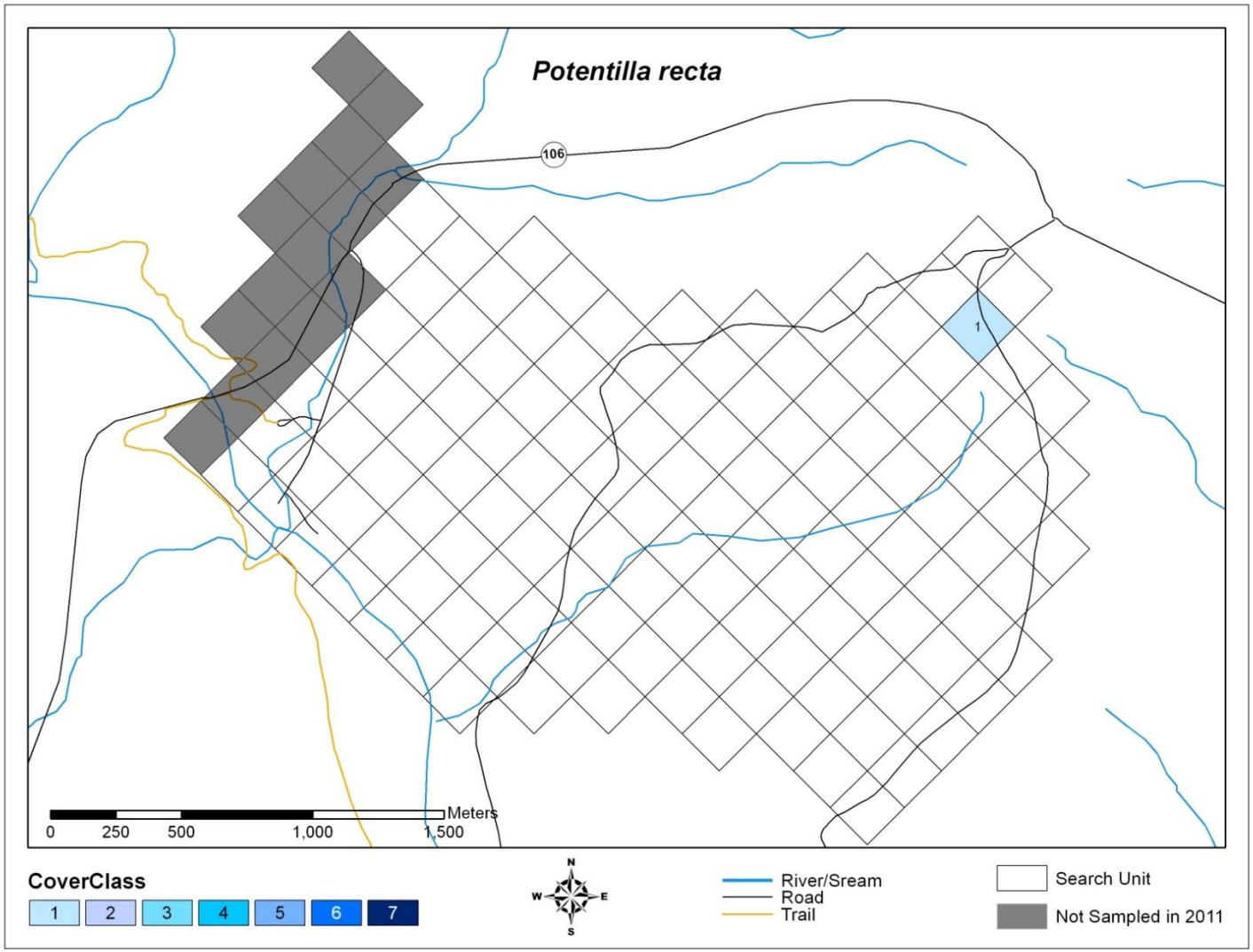

Figure 11. Abundance and distribution of *Potentilla recta* (sulphur cinquefoil) at Ozark National Scenic Riverways, 2011. Cover classes are as follows: 1=0.1-0.9 m^2, 2=1-9.9 m^2, 3=10-49.9 m^2, 4= 50-99.9 m^2, 5=100-499.9 m^2, 6= 499.9-999.9 m^2, 7= 1,000-4,999 m^2.

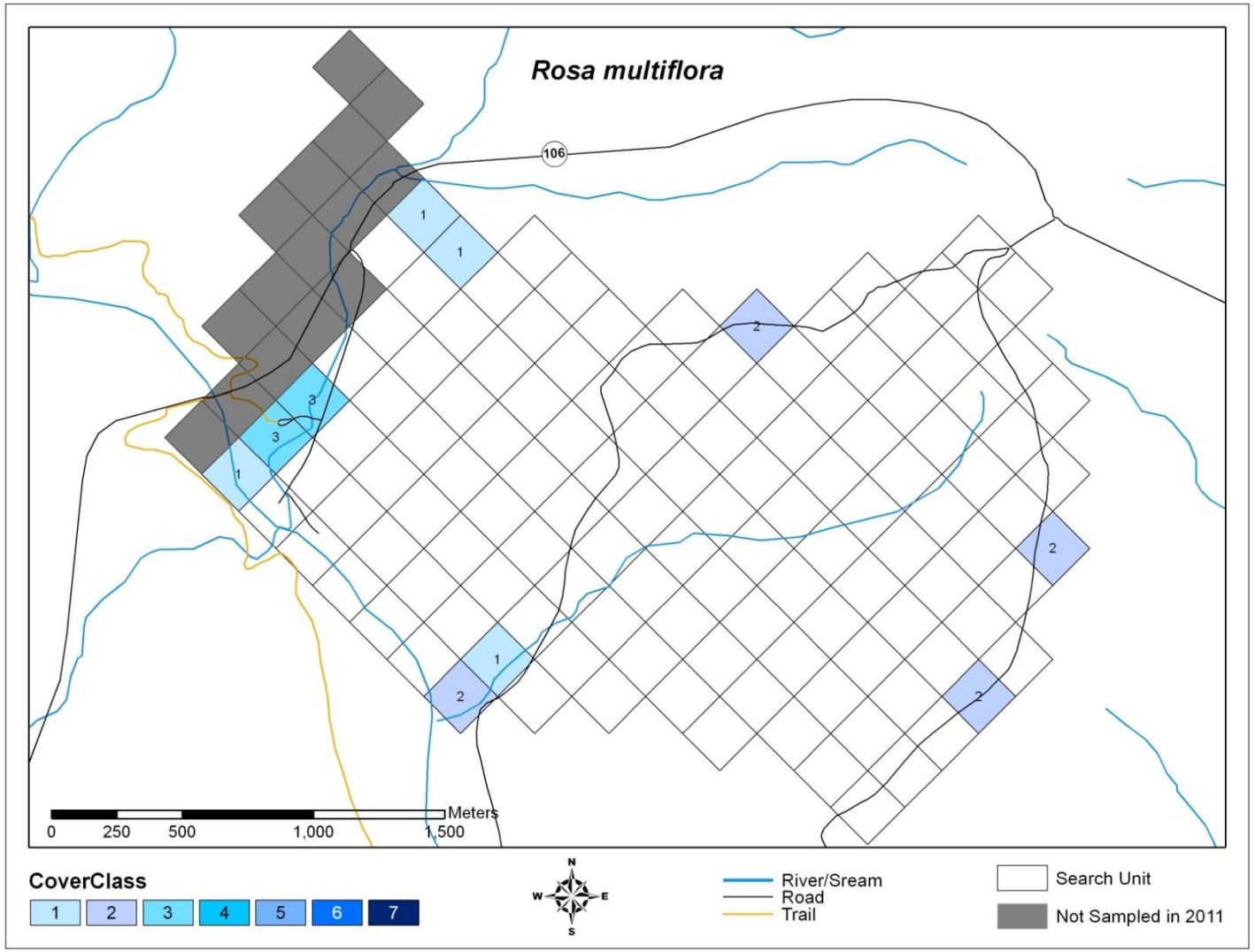

Figure 12. Abundance and distribution of *Rosa multiflora* (multiflora rose) at Ozark National Scenic Riverways, 2011. Cover classes are as follows: 1=0.1-0.9 m^2, 2=1-9.9 m^2, 3=10-49.9 m^2, 4= 50-99.9 m^2, 5=100-499.9 m^2, 6= 499.9-999.9 m^2, 7= 1,000-4,999 m^2.

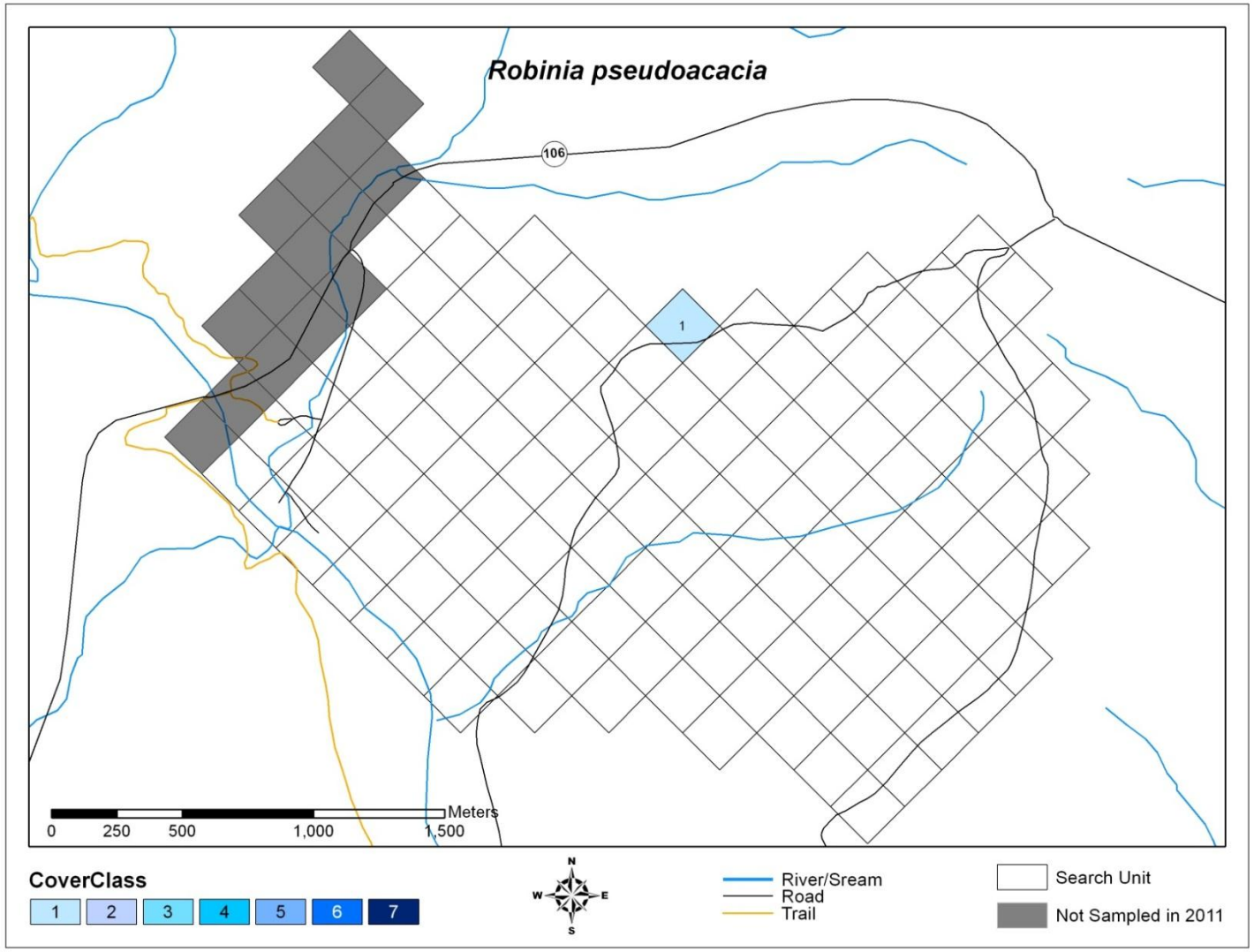

Figure 13. Abundance and distribution of *Robinia pseudoacacia* (black locust) at Ozark National Scenic Riverways, 2011. Cover classes are as follows: 1=0.1-0.9 m^2, 2=1-9.9 m^2, 3=10-49.9 m^2, 4= 50-99.9 m^2, 5=100-499.9 m^2, 6= 499.9-999.9 m^2, 7= 1,000-4,999 m^2.

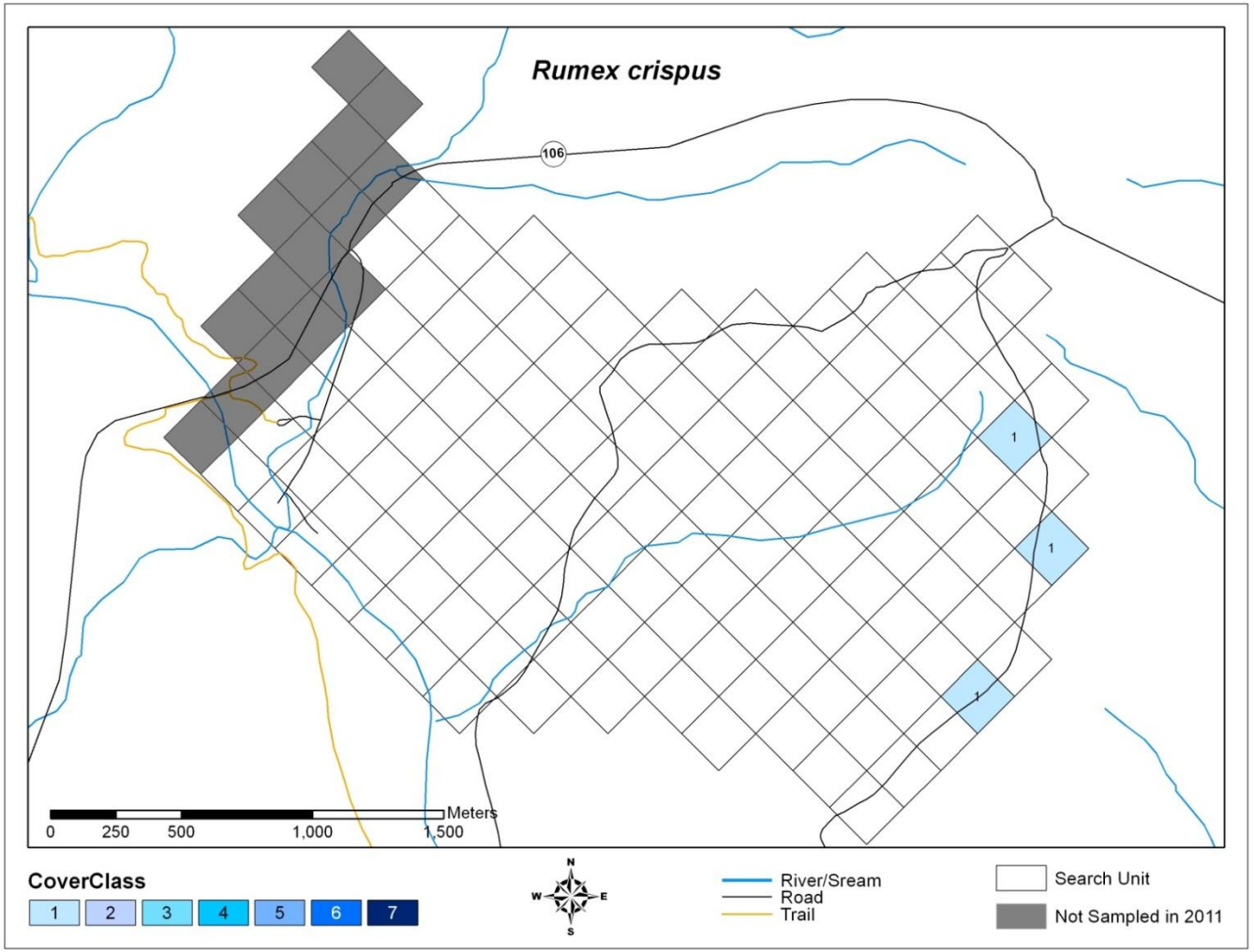

Figure 14. Abundance and distribution of *Rumex crispus* (curly dock) at Ozark National Scenic Riverways, 2011. Cover classes are as follows: 1=0.1-0.9 m^2, 2=1-9.9 m^2, 3=10-49.9 m^2, 4= 50-99.9 m^2, 5=100-499.9 m^2, 6= 499.9-999.9 m^2, 7= 1,000-4,999 m^2.

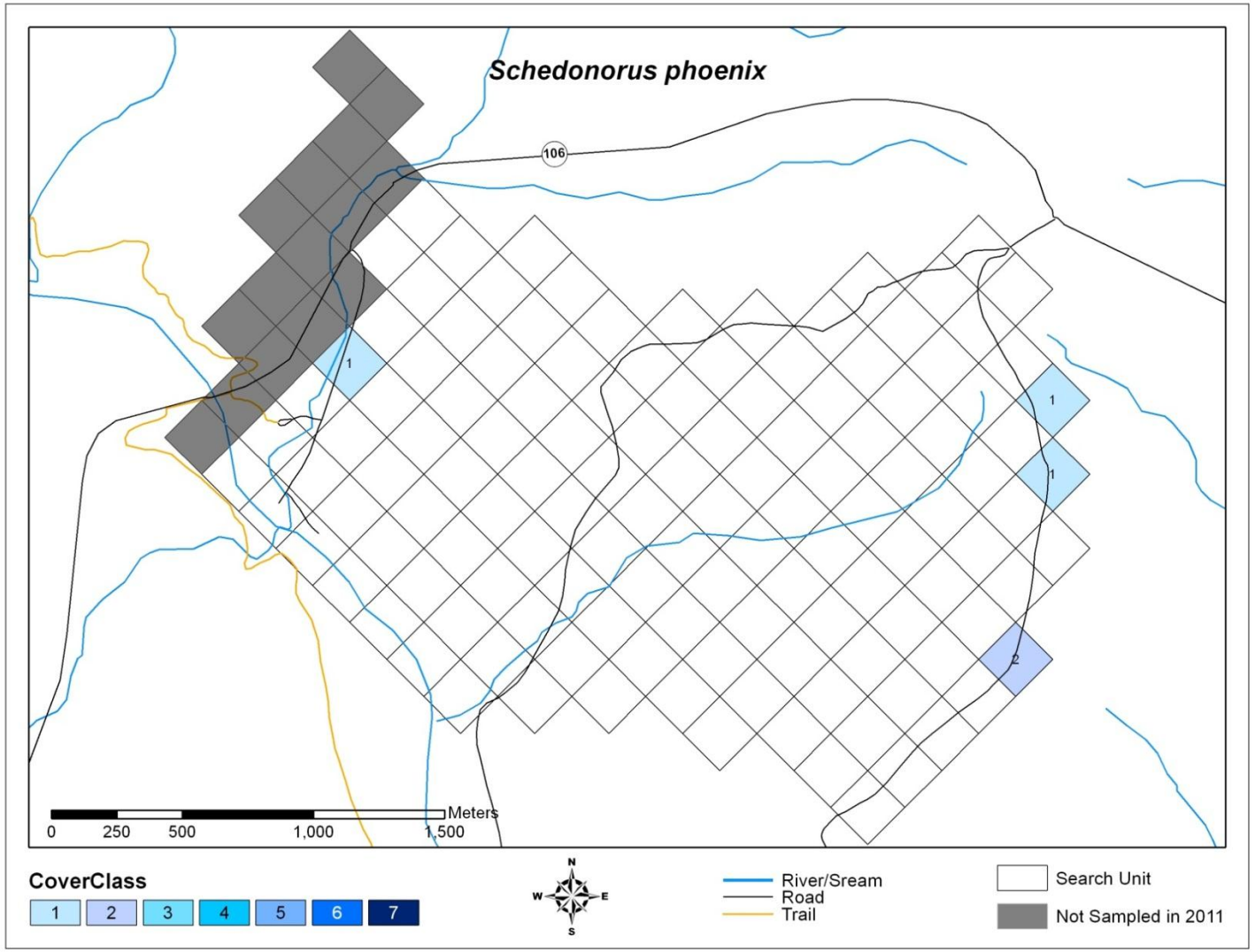

Figure 15. Abundance and distribution of *Schedonorus phoenix* (tall fescue) at Ozark National Scenic Riverways, 2011. Cover classes are as follows: 1=0.1-0.9 m^2, 2=1-9.9 m^2, 3=10-49.9 m^2, 4= 50-99.9 m^2, 5=100-499.9 m^2, 6= 499.9-999.9 m^2, 7= 1,000-4,999 m^2.

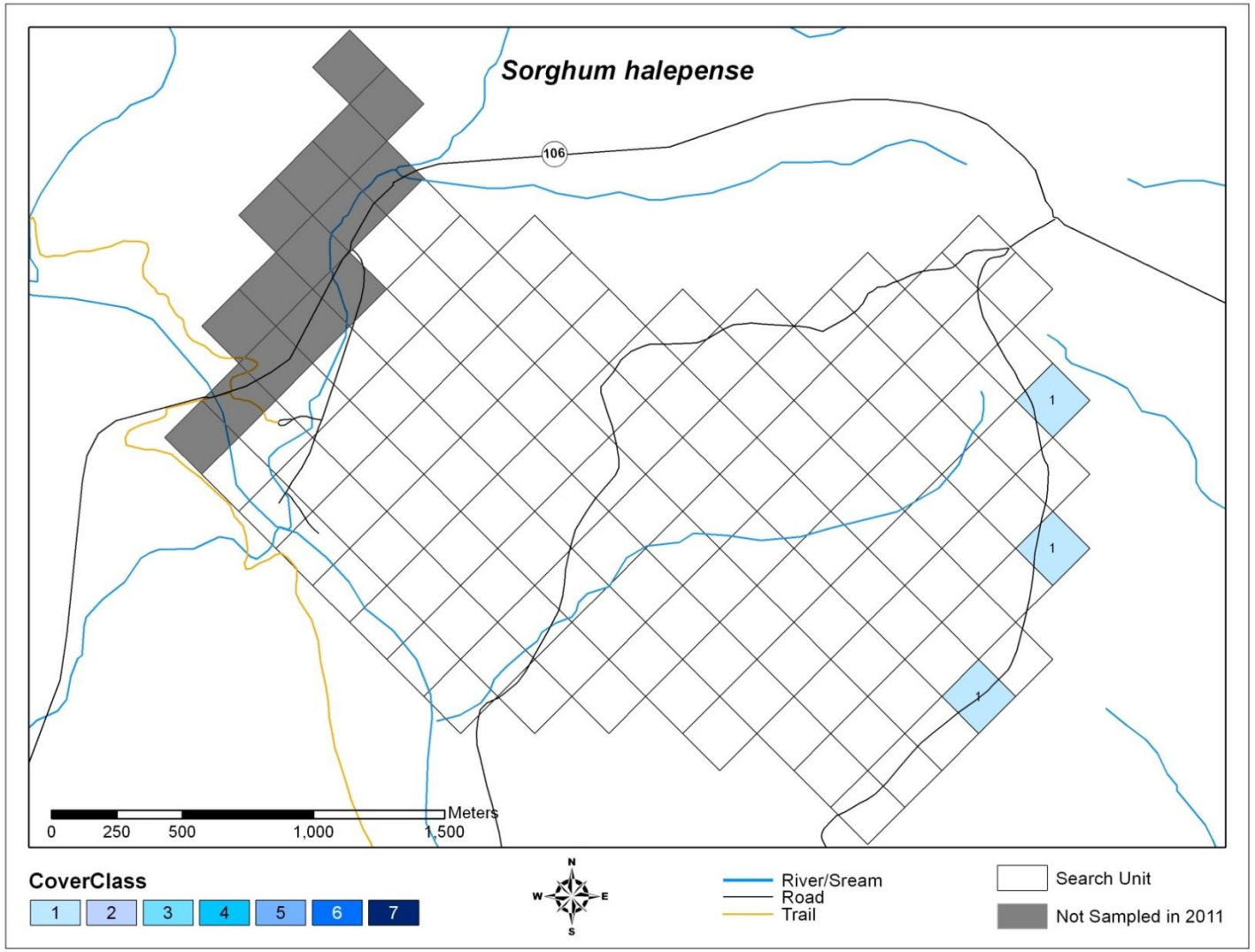

Figure 16. Abundance and distribution of *Sorghum halepense* (Johnsongrass) at Ozark National Scenic Riverways, 2011. Cover classes are as follows: 1=0.1-0.9 m^2, 2=1-9.9 m^2, 3=10-49.9 m^2, 4= 50-99.9 m^2, 5=100-499.9 m^2, 6= 499.9-999.9 m^2, 7= 1,000-4,999 m^2.

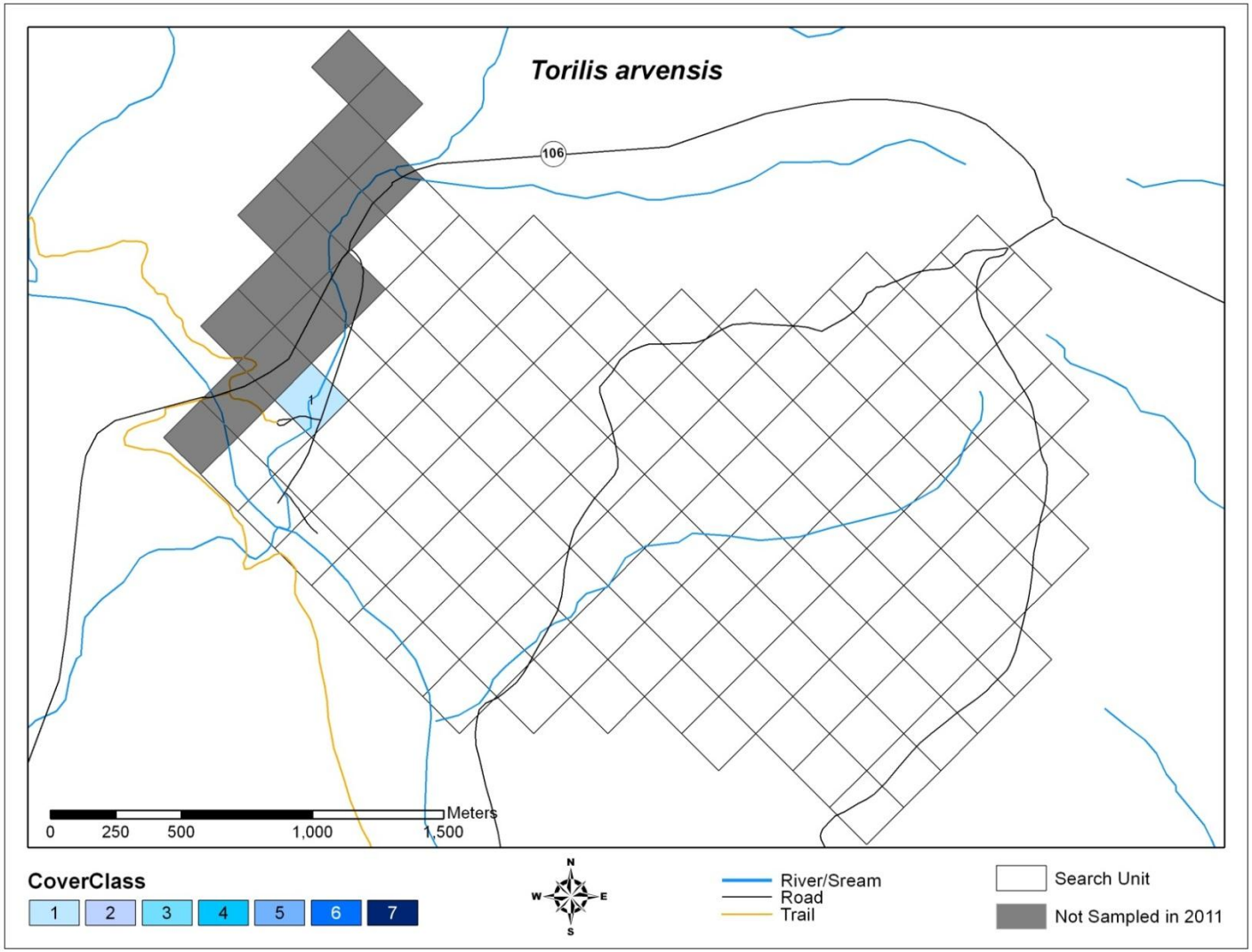

Figure 17. Abundance and distribution of *Torilis arvensis* (spreading hedgeparsley) at Ozark National Scenic Riverways, 2011. Cover classes are as follows: 1=0.1-0.9 m^2, 2=1-9.9 m^2, 3=10-49.9 m^2, 4= 50-99.9 m^2, 5=100-499.9 m^2, 6= 499.9-999.9 m^2, 7= 1,000-4,999 m^2.